DYNAMIC WEB PAGE CONSTRUCTION BASED ON DETERMINATION OF CLIENT DEVICE LOCATION

BACKGROUND OF THE INVENTION

5 **Technical Field**

This invention relates generally to information retrieval in a computer network. More particularly, the invention relates to a method and computer program product for dynamically serving a given web-page element (e.g., an

10 advertisement) based on a location of the requesting client device.

Description of the Related Art

The World Wide Web is the Internet's multimedia information retrieval system. In the Web environment,

15 client machines effect transactions to Web servers using the Hypertext Transfer Protocol (HTTP), which is a known application protocol providing users access to files (e.g., text, graphics, images, sound, video, etc.) using a standard page description language known as Hypertext

20 Markup Language (HTML). HTML provides basic document formatting and allows the developer to specify "links" to other servers and files. In the Internet paradigm, a network path to a server is identified by a so-called Uniform Resource Locator (URL) having a special syntax

25 for defining a network connection. Use of an HTML-compatible browser (e.g., Netscape Navigator or Microsoft Intern t Explorer) at a client machine involves

specification of a link via th URL. In response, the client makes a request to the server identified in the link and, in return, receives in return a document or other object formatted according to HTML. A collection

5   of documents supported on a Web server is sometimes referred to as a Web site.

In the past, client machines were typically desktop or laptop computers. Recently, the computer industry has sought to add computer processing and communications

10   capabilities to devices other than what would normally be considered a traditional computer. Such devices are quite varied and include, for example, personal digital assistants (PDAs), business organizers (e.g., IBM® WorkPad®, the 3Com® PalmPilot®, and the like),

15   smartphones, cellular phones, desktop screen phones, in-vehicle devices, other handheld devices, and the like. For convenience, these devices, as a class, are sometimes referred to as "pervasive computing" clients as they are devices that are designed to be connected to servers in a

20   computer network and used for computing purposes regardless of their location.

With client devices becoming more portable, there have also been attempts to customize web content to a particular user's location. One such technique is

25   described in IBM Technical Disclosure Bulletin, Vol. 41

No. 1, January 1998, titled "Method for Using Global
Position System to Find Close Services." In this
disclosur , a laptop comput r having a Global Position
System (GPS) creates a "cookie" with longitude and
5 latitude information. This cookie can be extracted by a
search engine when the user enters a search request to
allow searches to be performed based on the laptop's
location. In particular, the search engine's database
contains longitude and latitude information for each
10 business, and the search engine includes a routine that
calculates the distance between longitude and latitude
pairs. In use, the user navigates to the search engine
and fills in a form identifying a type of business (e.g.,
restaurant, theatre, etc.) to be located and the distance
15 he or she is willing to travel to that business. The
user submits this page to the search engine, which
extracts the cookie having the laptop position
information. For each service found in the database, the
distance routine is used to identify those services that
20 are "close" enough to the user's location. These search
results are then returned to the user.

While the technique described above is advantageous,
it is limited to search engine content. Thus, the user
merely receives a list of targeted URLs or links that
25 must then be evaluated. In the web environment, however,

there are many different types of page content other than links. To give just one example, most commercial web site pages include advertising in the form of banners or the like. While it is known in the prior art to serve a

5 given banner advertisement as a function of either the user's past browsing activities or keywords entered into a search engine, the targeted serving of such content based on client device location has not been attempted. Advertising would be much more effective if the

10 construction of the page returned to the user by the web server were done with knowledge of the user's location. Benefits to sellers of advertising would include the ability to sell targeted advertising capability to businesses that provide physical services like plumbing,

15 landscaping, medical care and the like, which are of most interest only to potential customers in fairly close proximity to their businesses, even though the site these customers may be browsing might be anywhere on the Internet.

20 It would be desirable to provide a mechanism that serves dynamic web page content based on the current position of the client device. This invention solves this problem.

BRIEF SUMMARY OF THE INVENTION

Dynamic web page content is generated and served as a function of client device location information. In one embodiment, a location determination mechanism,

5   e.g., a GPS receiver, associated with the requesting client machine passes the machine's location to a web server. The web server then builds dynamic page content based on the device location that is passed with the request. In an illustrative embodiment, the page includes an advertisement that identifies a given business establishment located in proximity to the user's then-current location.

10   According to a more particular aspect of the present invention, a method for serving a web page begins by storing a set of location-specific page elements. In response to a request for the web page from a client browser, a control routine parses the request to identify a geographic location data string identifying a location of the client browser that has made the request. The geographic location data string may be

15   generated at the client browser in a number of different ways, e.g., by a Global Positioning System (GPS) receiver coupled to the client computer, by a user manually entering his or her location coordinates, or the like. At the server, the web page is built dynamically using the geographic location data string to select a given one of the set of location-specific page elements and, preferably, an element having content

20   associated with or identifying a physical location in proximity to the location of the requesting client machine. The web page is then served in response to the request. In this way, targeted advertising or other page content is included in the web page as a function of the client browser location.

The f regoing has outlined some of the more pertinent objects and features of the present invention. These objects should be construed to be merely illustrative of some of the more prominent features and applications of the invention. Many other beneficial results can be attained by applying the disclosed invention in a different manner or

5　modifying the invention as will be described. Accordingly, other objects and a fuller understanding of the invention may be had by referring to the following Detailed Description of the Preferred Embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and the

advantages thereof, reference should be made to the following Detailed Description

5   taken in connection with the accompanying drawings in which:

Figure 1 is a representative system in which the present invention is implemented;

Figure 2 illustrates the preferred components of the dynamic page generator of

the present invention;

Figure 3 is a flowchart illustrating a preferred operating routine of the dynamic

10   page generator of the present invention; and

Figure 4 is a flowchart illustrating a preferred operation of the client location

determining routine of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A representative system in which the present invention is implemented is illustrated

in Figure 1. A plurality of Internet client machines10 are connectable to a computer

5   network Internet Service Provider (ISP) 12 via a network such as a dialup telephone

network 14. As is well known, the dialup telephone network usually has a given, limited

number of connections 16a-16n. ISP 12 interfaces the client machines10 to the remainder

of the network 18, which includes a plurality of web content server machines20.

Network 18 typically includes other servers (not shown) for control of domain name

10   resolution, routing and other control functions. A client machine typically includes a suite

of known Internet tools, including a Web browser, to access the servers of the network

and thus obtain certain services. These services include one-to-one messaging (e-mail),

one-to-many messaging (bulletin board), on-line chat, file transfer and browsing. Various

known Internet protocols are used for these services. Thus, for example, browsing is

15   effected using the Hypertext Transfer Protocol (HTTP), which provides users access to

multimedia files using Hypertext Markup Language(HTML). The collection of servers

that use HTTP comprise the World Wide Web, which is the Internet's multimedia

information retrieval system.

A given client machine and the server may communicate over the public

20   Internet, an intranet, or any other computer network. If desired, given

communications may take place over a secure connection. Thus, for example, a client

may communication with the server using a network security protocol, such as

Netscape's Secure Socket Layer (SSL) protocol.

A representative client is a personal computer, notebook computer, Internet appliance or pervasive computing devic (e.g., a PDA or palm computer) that is x86-, PowerPC®- or RISC-based. The client includes an operating system such as Microsoft Windows, Microsoft Windows CE or PalmOS. As noted above, the client includes a suite of Internet tools including a Web browser, such as Netscape Navigator or Microsoft Internet Explorer, that has a Java Virtual Machine (JVM) and support for application plug-ins or helper applications.

A representative pervasive client is x86-, PowerPC®- or RISC-based, that includes a realtime operating system such as WindRiver VXWorks™, QSSL QNXNeutrino™, or Microsoft Windows CE, and includes a graphics viewer such as a Web browser. An illustrative pervasive computer client may render documents in a markup language such as the Handheld Markup Language (HDML). As also illustrated in Figure 1, a given client machine preferably has a location determining mechanism 25 associated therewith. Mechanism 25 is typically a Global Positioning System (GPS) transceiver. The global position system transceiver 25 is a commercially available device. As is well-known, GPS is currently the most precise positioning system generally available to the general public. The GPS comprises a network of satellites orbiting the earth.

Each satellite transmits a ranging signal modulated on a
1.575 Ghz carrier. By monitoring the signal from a
plurality of satellites, GPS transceiver 25 can determine
the client machine's position, i.e. latitude, longitude

5   and altitude, to an accuracy of about 100 meters.
Differential GPS, also known in the art and available to
the public, is more accurate than standard GPS, but
requires an additional land-based transmitter and certain
regulatory approvals for its use. Differential GPS may

10 be used in the invention as well.

A representative web server is a computer comprising
a RISC-based processor 22, a UNIX-based operating system
24 and a web server program 26 such as IBM Netfinity or
WebSphere. OS 24 and web server program 26 are supported

15 in system memory 23 (e.g., RAM). The server includes an
application programming interface 28 (API) that provides
extensions to enable application developers to extend
and/or customize the core functionality thereof through
software programs including plug-ins, CGI programs,

20 servlets, and the like.

Figure 2 illustrates one such control program 30
that provides the functionality of the present invention.
This program is sometimes referred to herein as a
location-specific dynamic page generator as it enables

25 the web server to s rve web pages that include given page

content elements targeted to the user based on the location of the client machine. Thus, to give a representative example, a given web page may be served together with an advertisement that identifies a specific

5   business in proximity to the location of the client machine that issued the request for the web page.

Typically, location-specific web page elements (e.g., a set of targeted advertisements for a given business) are stored in a given location, e.g., the

10   server on which the control program is executing, or a third party server. Thus, the location-specific page elements may comprise a set of advertisements, each of which has content associated with a particular business located in a given area. To give a simple example, the

15   location-specific page elements may be a set of banner advertisements for a national restaurant chain, with each particular advertisement identifying the location of a particular franchise in a given city. Thus, when a user (in a given city) makes a request for a web page, an

20   advertisement targeted to the user can be pushed to the client machine with the rest of the requested page elements.

According to the present invention, the generator program is supported in system memory of a target server

25   and is executed by a processor. For illustrative

purposes, the generator program 30 is implemented as a
Java servl t and includes a number of components: a
manager 32 for controlling the overall function of the
program and for generating one or more instances of a
5   client response routine 34a-n. An instance of the client
response routine may be spawned when a client request is
received at the server. The client response routine
provides the basic functionality of the invention. As
will be seen, this routine parses the incoming request to
10   determine the location of the requesting client and to
identify a given one of a set of page elements 36a-n that
is to be served with the generated page based on the
location of the requesting client. In a first
embodiment, the page elements 36a-n are stored in the
15   server itself. Alternatively, one or more of the page
elements 36 are stored at another server, e.g., an ad
server. The generator program 30 may optionally include
a security routine 35 for verifying the authenticity of a
given client request before serving the dynamic page
20   content.

The operation of the generator program is
illustrated in the flowchart of Figure 3. It is assumed
that a set of page elements has been previously stored
either at the server or at another accessible location,
25   e.g., an ad server. The routin begins at step 40 by

launching the manager 32. The manager then performs a

test at step 42 to determine whether a given client

request has been received at the server. If not, the

routine cycles. If, however, the outcome of the test at

5   step 42 indicates that a request for a given web page has

been received, the manager continues at step 44 and

spawns an instance of the client response routine. The

client response routine parses the client request at step

46. A test is then performed at step 48 to determine

10   whether the client request includes a geographic location

data string identifying the location of the client

machine. If the outcome of the test at step 48 is

negative, the routine branches to step 50 and provides

the requested page without any location-specific page

15   elements. If, however, the outcome of the test at step

48 is positive, which indicates that the client request

includes a geographic location data string, the routine

continues at step 52. At this step, the client response

routine identifies a given one of a set of

20   location-specific page elements that will be used to

populate the web page. One of the ways that this is

accomplished is by having the routine compare the

location of the client with location data associated with

each given page element. The location data may be very

25   general (e.g., the name of a given city, town, county, or

other identifying feature), or it may be quite specific
(e.g., latitude and longitude). In the latter case, the
routine typically includes a subroutine or the like to
calculate the distance between the client and given

5   locations associated with the set of page elements. In
this way, a page element may be more specifically
targeted to the client machine's actual location.

At step 54, the client response routine performs a
test to determine whether the identified

10   location-specific page element is available at the
server. If so, the client response routine retrieves the
page element at step 56. If the location-specific page
element is unavailable at the server, the client response
routine identifies the URL of the page element. This is

15   step 58. At step 60, the client response routine builds
the requested page. In particular, at step 60, the
client response routine retrieves a flat file comprising
the page. At step 62, the routine generates a data
stream to be served back to the requesting client. At

20   step 64, the client response routine either inserts the
location-specific page element (retrieved at step 56) or
the URL (identified at step 58). At step 66, the data
stream is served back to the requesting client. At step
68, the client response routine reports back to the

25   manager that it has completed the response. At step 70,

the manager terminates the client response routine

instance to complete the processing.

There are many alternative ways to build the page

having specific page element(s) as a function of the

5 client location. This is step 60 described above... A

simple technique is to use dynamically-generated HTML,

i.e. database or CGI scripts that generate a web page on

the fly. Alternatively, the server may generate the page

using more advanced techniques, such as Microsoft's

10 active server page (ASP), Sun Microsystems's Java server

page (JSP), or the Extensible Style Sheet Language

(XSL/XSLT) being promoted by the World Wide Web

Consortium (W3C). These technologies provide for the

generation and serving of dynamic web page content by

15 enabling a page creator to write HTML and then to embed

pure programming logic inside the page markup.

Microsoft's ASP and Sun's JSP are very similar in that

they both are essentially web templates—that enable given

code (e.g., code written in Java) to be embedded in

20 static HTML to be served in response to a client browser

request. In an illustrative JSP implementation, a server

(and, in particular, a Java runtime servlet) responds to

a client .jsp request as follows: the servlet retrieves

a flat file corresponding to the requested page,

25 translates that file into a Java servlet, compiles the

servlet, class loads the s rvlet, and then invokes the

servlet to cause given (e.g., customized) web content to

be returned to the requesting browser.   The XSL/XSLT

approach is rooted in formatting and manipulating XML.

5   XSLT, in particular, provides extensible mechanisms for

defining templates to manipulate XML of any custom

Document Template Definition (DTD).   Any of these

techniques may be used to build the dynamic page

according to the inventive routine.

10   Thus, according to the present invention,

location-specific page element(s) are served with a given

web page.   The server at which the web page is hosted may

be located anywhere on the Internet.   Nevertheless, the

operator of that server may offer third parties the

15   ability to serve targeted advertisements or other page

content as a function of the requesting client's

location.   One of ordinary skill will appreciate that the

types of location-specific page content may be quite

varied.   Thus, while the present invention has been

20   described in the context of serving location-specific

banner advertisements, any given aspect of the page may

be client-location specific.   Thus, for example, the web

page may include community service information, emergency

broadcasts, local weather and news information, and the

25   like.   Of course, the particular page element content is

not a limitation of the present invention.

As noted above, in the preferred embodiment, the client machine includes a GPS transceiver for identifying the location thereof. This is not a limitation of the

5 present invention as other types of location-determining mechanisms may be used. For example, if the client is a handheld or wireless device (such as a PDA), its location may be determined by identifying some physical network device (e.g., such as a tower), which is typically done

10 during the use of such device to communicate with another device or system in the network in which the client is supported. Generalizing, the present invention may be used with any client device that has the capability of passing (to a server) information about its location so

15 that the server can dynamically generated a page and return the page to that client. Of course, the client device need not know its precise location provided it has the capability of passing the location information (preferably in some universal coordinate system such as

20 latitude, longitude, zip code, other predefined information, or the like) to the server.

In one preferred embodiment, the client machine may include a location determining software routine for identifying the coordinates of the client and processing

25 those coordinates into a form that can be passed to the

remote server. Figure 4 is a flowchart of one embodiment
of the location determining software.

The routine begins at step 72 by initializing the
routine. At step 74, the routine tests to determine
5 whether a given client request has been initiated. If
not, the routine cycles. If the outcome of the test at
step 74 is positive, the routine tests at step 76 to
determine whether client location data is to be passed
with the request. If not, the routine returns back to
10 step 74. If, however, client location data is to be
passed with the request, the routine continues at step
78. At this step, the routine retrieves location
coordinate data. For example, if the client machine has
an associated GPS transceiver, the routine accesses the
15 GPS receiver software and retrieves the current location
data. If the client machine does not include a GPS, the
routine must obtain the data in some other way. As one
example, the routine may prompt the user to enter
location data via a pop-up dialog. Alternatively, the
20 routine may access and retrieve pre-stored data about the
user's current location. Yet another alternative is for
the routine to access a cookie in the browser cookie file
that has been set with given machine location-specific
profile data. Of course, these examples are merely
25 representative.

At step 80, the routine parses the coordinate data into a geographic location data string. At step 82, this string is passed into the HTTP request to the target server. This completes the client-side processing.

Thus, according to the present invention, the client machine's location coordinates may be provided to the remote server via a variety of techniques, such as client-side modification of cookies in the browser's cookie file prior to browser invocation, access to these coordinates from an authorized Java applet of ActiveX component, passing of the coordinates via an HTML form that is constructed on the client with the coordinates as form variables, or through the actions of a browser plug-in specified as part of the location determining mechanism software.

Thus, the client-side location determining routine may be implemented in any convenient fashion on the machine, e.g., a browser plug-in, a Java applet, a Javascript, an ActiveX control, code implemented within the browser itself, or by a standalone program.

Users of client devices, especially mobile devices, would be well-served by the present invention. For example, a person may use his or her laptop or PDA in a given city or town and receive information or advertisements specific to that location. Moreover, the

present invention provides a web site operator with an opportunity for increased revenue from advertising that can be achieved even though the hosting site is far removed from the locale. Indeed, web site operators

5 anywhere could offer any other business the opportunity to have their advertisements pinpointed for accurate delivery in terms of the location of the users who would receive the ads.

As noted above, the inventive page generator

10 mechanism is preferably implemented in or as an adjunct to a target web server. Although not meant to be limiting, the above-described functionality is preferably implemented as a Java servlet or as standalone native code. Generalizing, the above-described functionality is

15 implemented in software executable in a processor, namely, as a set of instructions (program code) in a code module resident in the random access memory of the computer. Until required by the computer, the set of instructions may be stored in another computer memory,

20 for example, in a hard disk drive, or in a removable memory such as an optical disk (for eventual use in a CD ROM) or floppy disk (for eventual use in a floppy disk drive), or downloaded via the Internet or other computer network.

25 In addition, although the various methods described

are conveniently implem nted in a general purpose
computer selectively activated or reconfigured by
software, one of ordinary skill in the art would also
recognize that such methods may be carried out in
5   hardware, in firmware, or in more specialized apparatus
constructed to perform the required method steps.

Further, as used herein, a Web "client" should be
broadly construed to mean any computer or component
thereof directly or indirectly connected or connectable
10   in any known or later-developed manner to a computer
network, such as the Internet. The term "Web server"
should also be broadly construed to mean a computer,
computer platform, an adjunct to a computer or platform,
or any component thereof. Of course, a "client" should
15   be broadly construed to mean one who requests or gets the
file, and "server" is the entity which downloads the
file.

One of ordinary skill will appreciate that the
present invention may be varied to provide additional
20   functionality without modifying the basic operation
described above. Thus, for example, the server may
include control logic that stores a given
dynamically-generated page (generated in response to a
first request) in a page cache. As additional client
25   requests are received at the server (e.g., from other

users), the control logic may examine these requests to
determine whether they originate from a location
reasonably proximate (e.g., within a given 1 mile radius)
from the first request. If so, the server control logic

5   may merely escape out (of the above-defined routine) and
serve the previously-cached page rather than having to
re-generate it.

As another alternative, if the server control logic
determines that a particular user has issued multiple

10   client requests from a same or similar location, the
logic may "recognize" this history and serve a different
advertisement (or other given content) in the
dynamically-generated page.

Having thus described our invention, what we claim

15   as new and desire to secure by Letters Patent is set
forth in the following claims.